

## How do you define the value of something if it's free? Observations on Caltech's Institutional Repository

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Defining "Value" in Scholarly Communications:  
Evolving Ways of Evaluating Impact on Science

249<sup>th</sup> American Chemical Society Meeting  
Denver, Colorado

March 22, 2015  
CINF-9

It's a pleasure to be a part of this because one of my favorite conversations to have with people in the field is about the relationship (and decoupling) between price, cost and value. The previous talks have looked at the impact of data and personal or social marketing, and I look forward to the panel discussion. My presentation has a unique aspect on this in that it is, to a degree, a mix of all of these, plus one that hasn't been specifically addressed yet – trying to determine impact from the point of view of the Academic Institution. I want also to thank my co-author on this presentation, George Porter, who was a driving force behind the creation and expansion of our repository.




## California Institute of Technology

AAU member  
 ~2200 students, ~300 faculty, 600 researchers  
 6 Divisions, ~25 Options

- Biology & Biological Engineering
- Chemistry & Chemical Engineering
- Engineering & Applied Sciences
- Geology & Planetary Sciences
- Humanities and Social Sciences
- Physics, Math and Astronomy

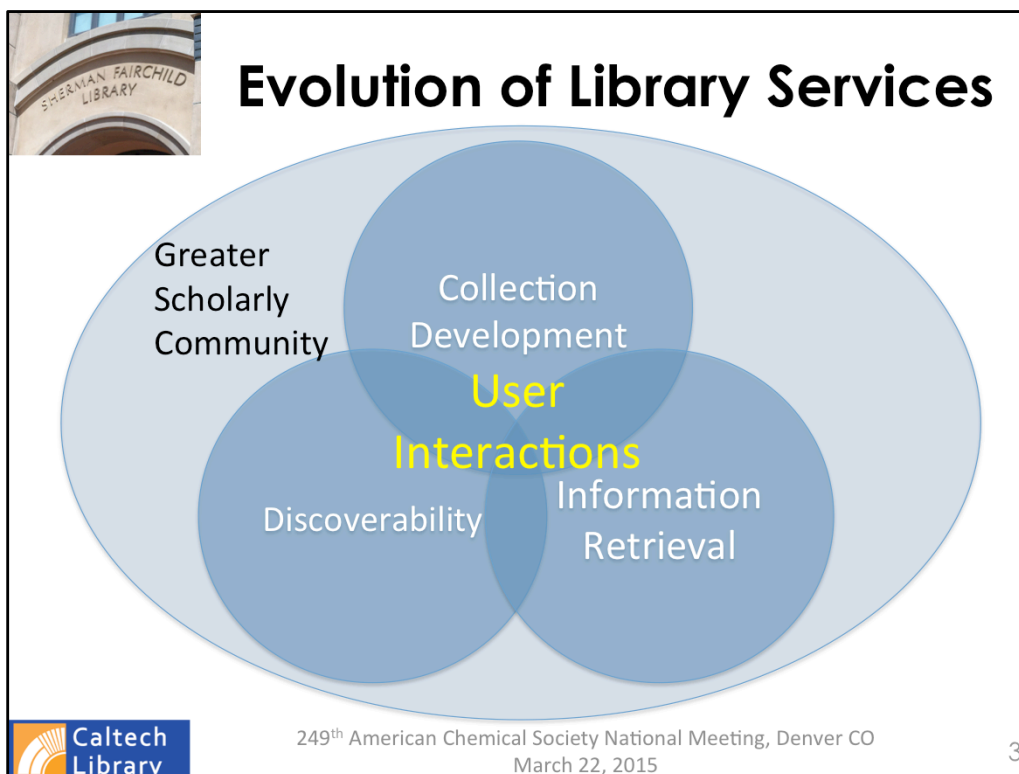
150-200 PhD dissertations per calendar year

## Sherman Fairchild Library

One of 5 libraries on campus  
 Opened in 1997, 24 hours  
 Serves all science & engineering disciplines  
 410,000 monographs (~7% electronic)  
 2,100 journals (90% electronic)

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First a little background about Caltech and the Library. The past few years have seen between 150 and 200 PhD dissertations granted per year by the Institution. We currently have 6 subject librarians plus our Repository Librarian. We are a small operation, and thus strategically choose our initiatives.



My last ACS talk in San Francisco focused on “internal” library initiatives serving primarily Caltech faculty and students. At the very end, I briefly mentioned our Institutional Repository, and its role in serving the Greater Scholarly Community. I’m pleased to be able to talk now more about how this expands to the world outside of Caltech in terms of the world accessing our materials, and how we assist our researchers with communicating with “the world” in terms of information promotion and legal compliance. I’m going to describe our repository and our services, and then towards the end, look at this service and show how it ties in with our institutional mission.



## Caltech Collection of Open Digital Archives (Caltech CODA)

- Consists of several different repositories, active since 2001
- **CaltechAUTHORS (47K records)** – scholarly output (articles, book chapters, books, individual conference papers, etc.)
- **CaltechTHESIS (8K records)** – Primarily Ph.D. Dissertations, some M.S. and Undergraduate
- CaltechCampusPubs, CaltechOH, CaltechLabNotes, CaltechES, CaltechCONF
- <http://libguides.caltech.edu/CODA>



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The Caltech Institutional Repository is formally known as Caltech CODA – the Caltech Collection of Open Digital Archives. Started in 2001, it is comprised of several different repositories. I will focus on two of them today – CaltechAUTHORS and CaltechTHESIS. Other repositories are CampusPubs which contains our student newspaper and yearbooks, OH which has alumni oral histories, LabNotes which has notebooks and research papers, ES which contains the Engineering & Science magazine, and CONF which houses conference proceedings. More information can be found on our CODA LibGuide.





## CaltechAUTHORS

- “On March 16, 2009, the Faculty Board unanimously approved a motion that Caltech Faculty support the creation of the Caltech Collection, and that the library be charged to create and maintain this collection.”
- Maintained by Library Staff
  - Weekly literature searches in Web of Science, SciFinder, PubMed & MathSciNet
- Enhanced metadata including grant numbers, PMCIDs, OA Status, and (recently) ORCIDs
- “Historical” projects as requested


<http://libguides.caltech.edu/CODA>  
<http://libguides.caltech.edu/CaltechOAPolicyFAQ>  
[http://library.caltech.edu/coda/OA\\_Policy\\_6.10.2013.pdf](http://library.caltech.edu/coda/OA_Policy_6.10.2013.pdf)



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CaltechAUTHORS was initially launched in 2001 and populated two ways. Motivated individuals (a few faculty and post docs) deposited their own work, and library staff harvested papers based on the ability to make the Version of Record freely available on behalf of the author. In 2009, CaltechAUTHORS was designated by the Faculty Board as the official repository for Caltech scholarly output. Today, staff are trained to perform weekly address/affiliation searches of Web of Knowledge, SciFinder, PubMed, and MathSciNet to search for citations and enter the relevant metadata and files into the repository. Librarians review submissions before posting. Historical “backfile” projects to complete scholarly records of faculty are done as requested and as time permits otherwise.



## CaltechAUTHORS and Caltech's Open Access Policy

- Caltech Open Access policy adopted June 10, 2013; effective January 1, 2014
  - “The Faculty of the California Institute of Technology is committed to disseminating the fruits of its research and scholarship as widely as possible.”
  - “...each Faculty member grants to the California Institute of Technology a nonexclusive, irrevocable, worldwide license to exercise any and all rights under copyright relating to each of his or her scholarly articles...”


<http://libguides.caltech.edu/CODA>  
<http://libguides.caltech.edu/CaltechOAPolicyFAQ>  
[http://library.caltech.edu/coda/OA\\_Policy\\_6.10.2013.pdf](http://library.caltech.edu/coda/OA_Policy_6.10.2013.pdf)



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CaltechAUTHORS allows faculty to comply with the University's open access policy, and allows for manuscripts and/or final PDF copies of papers to be made publicly available in compliance with copyright. Waivers are granted when needed for articles appearing in non-cooperating journals (such as Nature).




# CaltechAUTHORS

## The Mechanics


**Mechanistic analysis of an asymmetric palladium-catalyzed conjugate addition of arylboronic acids to  $\beta$ -substituted cyclic enones**

Boeser, Cornelia L. and Holder, Jeffrey C. and Taylor, Buck L. H. and Houk, K. N. and Stoltz, Brian M. and Zare, Richard N. (2015) *Mechanistic analysis of an asymmetric palladium-catalyzed conjugate addition of arylboronic acids to  $\beta$ -substituted cyclic enones*. Chemical Science, 6 (3), pp. 1917-1922. ISSN 2041-6520 .  
<http://resolver.caltech.edu/CaltechAUTHORS:20150313-143109436>



PDF

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 433Kb



PDF


PDF - Supplemental Material  
[Creative Commons Attribution](#).  
 2161Kb

**Related URLs:**

URL	URL Type	Description
<a href="http://dx.doi.org/10.1039/c4sc03337j">http://dx.doi.org/10.1039/c4sc03337j</a>	DOI	Article
<a href="http://pubs.rsc.org/en/Content/Article/andinn/2015/SC/C4SC03337J">http://pubs.rsc.org/en/Content/Article/andinn/2015/SC/C4SC03337J</a>	Publisher	Article

**Funders:**

Funding Agency	Grant Number
NSF	CHE-1205646
Stanford University Postdoctoral Fellowship	UNSPECIFIED
University of Utah	10029173-S2
Air Force Office of Scientific Research (AFOSR)	FA9550-12-1-0481
Caltech	UNSPECIFIED



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The deposit process involves filling out a form and attaching articles and supplementary information. These are made publicly available when possible (for example when an article has a CC license or an author manuscript version is allowed to be posted). Metadata is added, including author names and identifiers, links to articles & supplementary information, and funding information. Administrative staff often request training on how to deposit for their faculty.

# CaltechAUTHORS: Faculty Webpages

**Caltech** Division of Biology and Biological Engineering

APPLY CONTACT GIVE DIRECTORY ACCESS

What are you interested in?

About People Research Academics News and Seminars Jobs Support BBE

**Eric H. Davidson**

Norman Chandler Professor of Cell Biology

B.A., University of Pennsylvania, 1958; Ph.D., Rockefeller University, 1963. Visiting Assistant Professor of Biology, Caltech, 1970; Associate Professor, 1971-74; Professor, 1974-81; Chandler Professor, 1982-.

Research Areas: *Developmental Biology and Genetics Systems Biology*

*An Integrated Approach to the Study of Embryonic Development in*

**PUBLICATIONS**


- Yin, Zongjun and Zhu, Maoyan and Davidson, Eric H. and Bottjer, David J. and Zhao, Fangchen and Tafforeau, Paul (2015) Sponge grade body fossil with cellular resolution dating 60 Myr before the Cambrian. *Proceedings of the National Academy of Sciences of the United States of America* . ISSN 0027-8424. (In Press) [Download](#)
- Barsi, Julius C. and Li, Enhu and Davidson, Eric H. (2015) Geometric control of ciliated band regulatory states in the sea urchin embryo. *Development* . ISSN 0950-1991. (In Press) [Download](#)
- Gao, Feng and Thompson, Jeffrey R. and Petsios, Elizabeth and Erkenbrack, Eric and Moats, Rex A. and Bottjer, David J. and Davidson, Eric H. (2015) Juvenile skeletogenesis in anciently diverged sea urchin clades. *Developmental Biology* . ISSN 0012-1606. (In Press) [Download](#)
- Davidson, Eric (2014) Brief Notes on the Meaning of a Genomic

**Caltech Library**

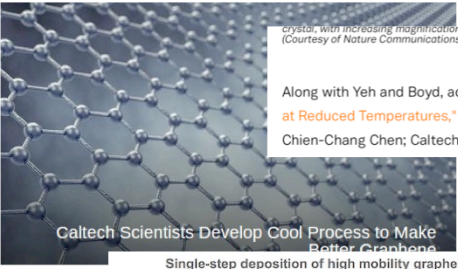
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Caltech introduced a new design and layout for the campus websites, which included an option to link directly to CaltechAUTHORS to display an up-to-date list of a faculty member's publications. There are also advanced options for faculty to create and display custom lists. From my time at the University of Florida, I know this can be an important "marketing" tool (insomuch as Caltech needs marketing) – no one like to see a website that is outdated and a publication list that stopped in 2007. CaltechAUTHORS makes this extremely easy.



# CaltechAUTHORS: Media Relations




crystal, with increasing magnification from left to right.  
(Courtesy of Nature Communications)

says. "You can't do this if you have a sheet of graphene that has uncontrollable defects in different places."

Along with Yeh and Boyd, additional authors on the paper, "Single-Step Deposition of High-Mobility Graphene at Reduced Temperatures," include Caltech graduate students Wei Hsiang Lin, Chen Chih Hsu and Chien-Chang Chen; Caltech staff scientist Marcus Teague; Yuan-Yen Lo, Tsung-Chih Cheng, and Chih-I Wu of

**Caltech Scientists Develop Cool Process to Make Better Graphene**

**Single-step deposition of high mobility graphene at reduced temperatures**  
Boyd, D. A. and Lin, W.-H. and Hsu, C.-C. and Teague, M. L. and Cheng, C.-C. and Lo, Y.-Y. and Chan, W.-Y. and Su, W.-B. and Chang, T.-C. and Chang, C.-S. and Wu, C.-I. and Yeh, N.-C. (2015) Single-step deposition of high mobility graphene at reduced temperatures. Nature Communications, 6 (3). Art. No. 6620. ISSN 2041-1723. <http://resolver.caltech.edu/CaltechAUTHORS:20150209-143834331>

 PDF (Supplementary Figures 1-9 and Supplementary Notes 1-2) - Related URLs:  
See Usage Policy.  
888Kb


Use this Persistent URL to link to this item: <http://resolver.caltech.edu/CaltechAUT>

**Abstract**

Current methods of chemical vapour deposition (CVD) of graphene on copper are processing steps and by high temperatures required in both preparing the copper i growth. Here we demonstrate a plasma-enhanced CVD chemistry that enables the growth of graphene in a single step, at reduced temperatures (<420 °C), and in a matter of minutes. Growth on copper foils is found to nucleate from arrays of well-aligned domains, and the ensuing films possess sub-nanometre smoothness, excellent crystalline quality, low strain, few defects and room-temperature electrical mobility up to  $(6.0 \pm 1.0) \times 10^4 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ , better than that of large, single-crystalline graphene derived from thermal CVD growth. These results indicate that reduced temperature and copper foil substrates are not necessary for producing high-quality graphene.

<http://www.caltech.edu/news/caltech-scientists-develop-cool-process-make-better-graphene-45961>  
<http://resolver.caltech.edu/CaltechAUTHORS:20150209-143834331>


URL	URL Type	Description
<a href="http://dx.doi.org/10.1038/ncomms7620">http://dx.doi.org/10.1038/ncomms7620</a>	DOI	Article
<a href="http://www.nature.com/ncomms/2015/150318/ncomms7620/full/ncomms7620.html">http://www.nature.com/ncomms/2015/150318/ncomms7620/full/ncomms7620.html</a>	Publisher	Article
<a href="http://hdl.handle.net/10.2310">http://hdl.handle.net/10.2310</a>	Publisher	Article
<a href="http://www.nature.com/ncomms/2015/150318/ncomms7620/extra/ncomms7620-s1.pdf">http://www.nature.com/ncomms/2015/150318/ncomms7620/extra/ncomms7620-s1.pdf</a>	Publisher	Supplementary Information



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Recently the Library has partnered with the Caltech Media Relations department to provide ongoing support to enhance Caltech Press Releases with direct links to papers, including full text where possible. A recent paper on graphene is an example of this. The work is highlighted on the Caltech homepage, and the link in the press release to the scientific article takes a user to the citation in CaltechAUTHORS. From here the user can freely view the abstract, grant and author information, and other metadata. If the article is freely available in CaltechAUTHORS, a direct link to it is provided. Links to publisher pages and other repositories are also provided, and a user who has a subscription to the journal can access it directly through them.




## CaltechAUTHORS: Global Reach

- Back-end search to retrieve articles with keywords of interest
- Use article Eprint ID numbers to retrieve access IP addresses
- Map global access information using OpenHeatMap.com

Biophotonics  
 Nanofluidics  
 Nanophotonics

Natural Products  
 Organometallics



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As of now AUTHORS has just over 47,000 records, and almost 6 million downloads since July 2008. There has also been a significant increase in referrals from the Caltech homepage due to the Media Relations effort. This is an access ratio of about 127:1 (6M downloads / 47K articles). So, in terms of impact, we can see that people are looking at our content (but like Tony said, views don't necessarily translate to impact). Eprints currently allows heatmap generation for individual articles or authors, but not by a topic. We're curious about the global reach of papers on the specific topics listed here.



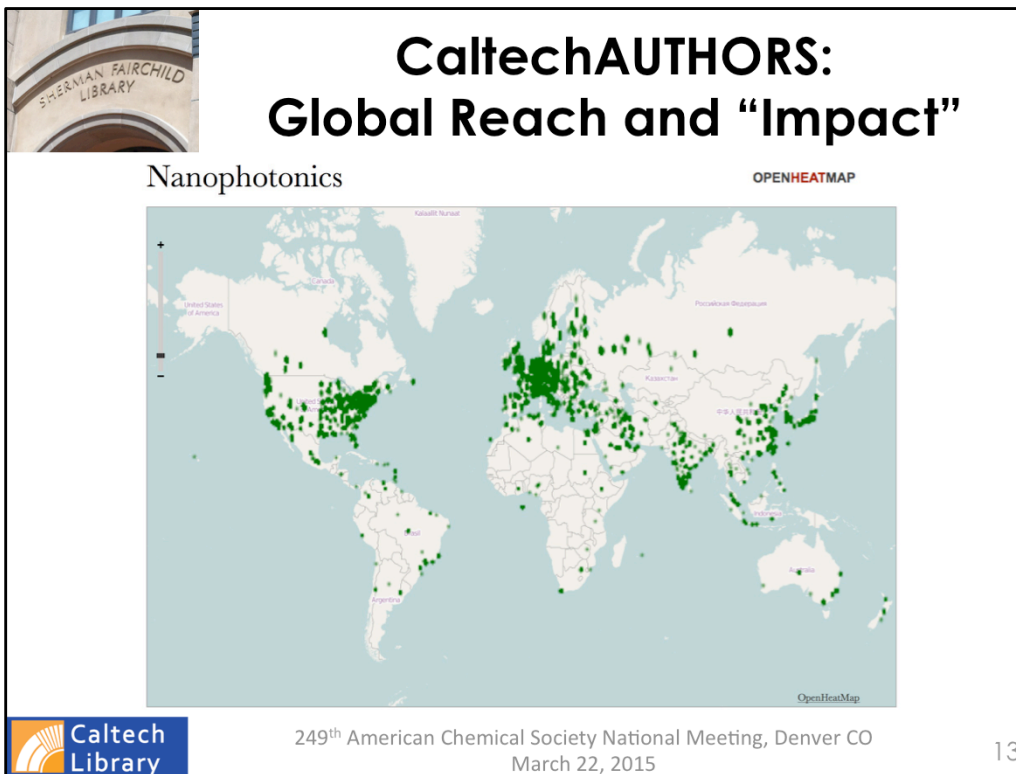
4 papers, ~2700 accesses

To get an idea of the global reach of CaltechAUTHORS we used the following procedure to analyze access data. The keywords indicated were searched against records in Eprints, matching on Title, Abstract, or Keyword, and the relevant articles were identified. The access records for those articles were then downloaded, and the IP's were uploaded to OpenHeatMap.com to generate the maps.

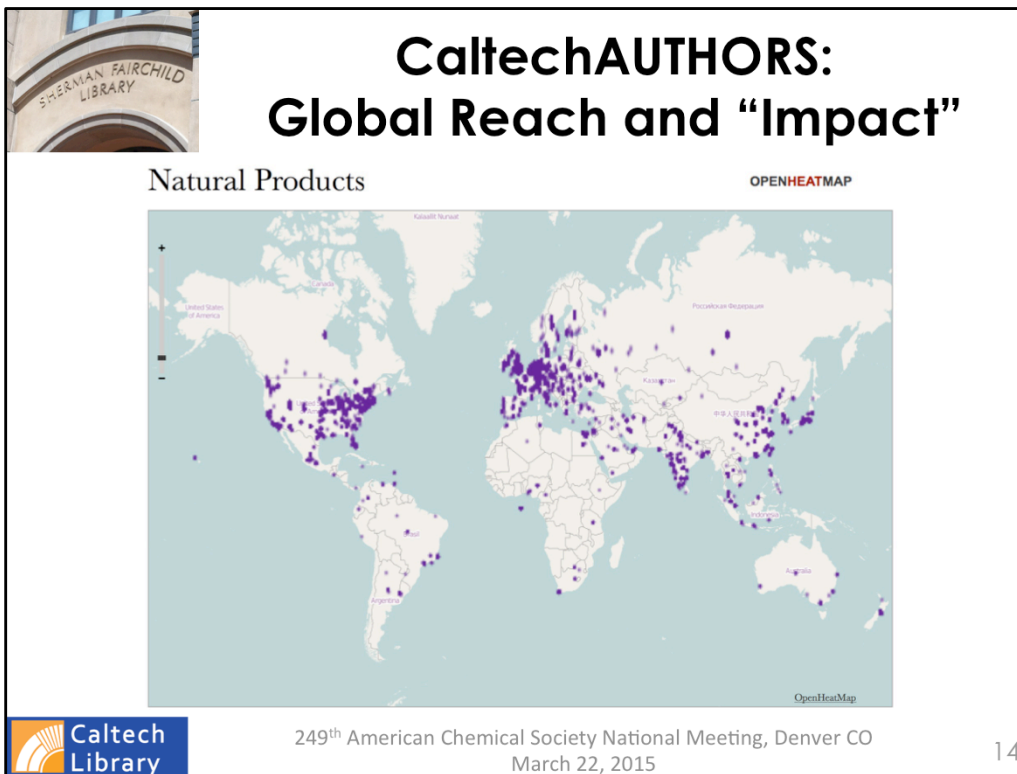




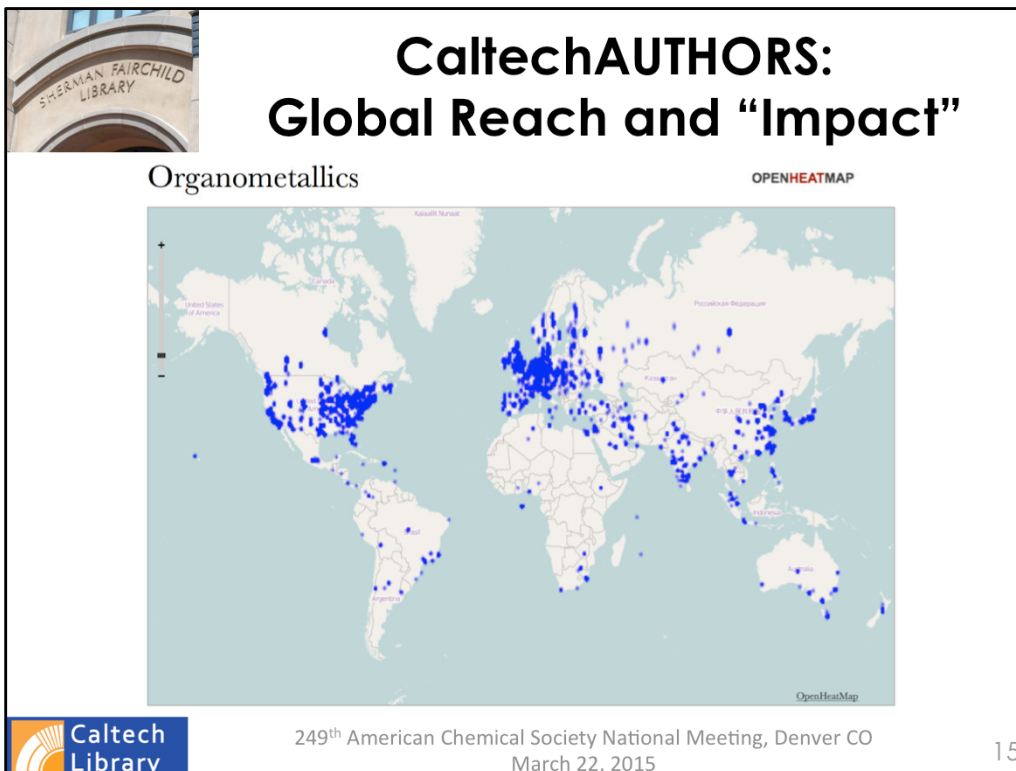
8 papers, ~19,000 accesses




34 papers, ~39,700 accesses



50 papers, ~41,300 accesses

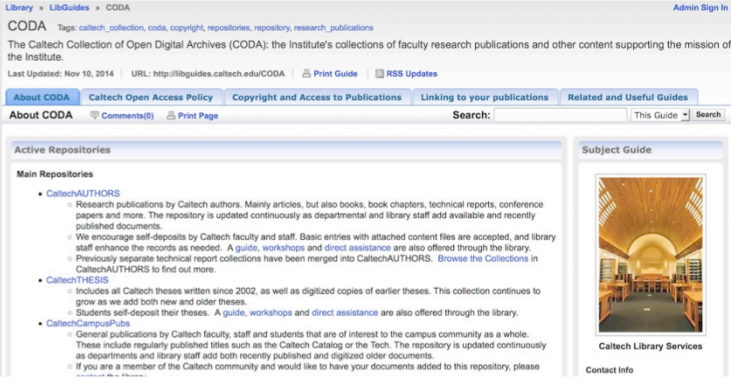


46 papers, ~37,700 accesses




# CaltechAUTHORS: Outreach

- Classes
  - For the Community
  - For Staff




<http://libguides.caltech.edu/CODA>



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George and Kathy teach classes on CaltechAUTHORS. We have two flavors – one for the general community to learn about what’s in it and how they can contribute, and one specifically for faculty support staff. The staff one focuses on depositing, and is usually of interest to those faculty who want to have their complete publication record in CaltechAUTHORS to use on their website, and also going forward for things like the new NIH Biosketch Bibliography section. This was a very recent development in which I worked with the NIH to have institutional repository bibliographies allowed as acceptable links in the Biosketch, and I would be happy to discuss that in the Q&A or later on during the conference.



# CaltechTHESIS

- Voluntary in 2001, mandatory for all candidates as of July 2002
- Ability to restrict when needed

**Synthetic applications and methodological developments of donor-acceptor cyclopropanes**


Citation


Goldberg, Alexander F. G. (2013) *Synthetic applications and methodological developments of donor-acceptor cyclopropanes*. Dissertation (Ph.D.), California Institute of Technology.  
<http://resolver.caltech.edu/CaltechTHESIS:02202013-172928174>

Abstract

Donor-acceptor cyclopropanes are a versatile class of synthetic intermediate: ring-opening reactions and formal cycloadditions, and employed in numerous have developed new Lewis acid mediated cycloadditions for the synthesis of fi applied existing a transition metal catalyzed cyclopropanes cycloaddition meth

Thesis Files


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 [PDF \(14 about the author\)](#)  
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 29Kb

10-20 requests/month

~8900 theses, ~1.4M downloads in 2014


Douglas, Taking the Plunge: Requiring the ETD, ETD 2003, Berlin, Germany. <http://resolver.caltech.edu/CaltechLIB:2003.003>  
 Coles & Johnson (2010) *Moving Electronic Theses from ETD-db to EPrints: The Best of Both Worlds*  
<http://resolver.caltech.edu/CaltechLIB:2010.001>



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Download ratio of 157:1. Alumni who graduated before the ETD requirement occasionally request to have their dissertations scanned and made available, but the majority of requests are from scholars from around the world. When a request comes in, library staff attempt to contact the author and have them fill out a permissions form, after which the dissertation is scanned and made freely available. People want to read our work, as evidenced by the requests.



# CaltechTHESIS Outreach

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**Caltech Theses** Tags: dissertations, theses, thesis

Ph.D. theses must be submitted in electronic form as part of the graduation requirements for Caltech. This guide serves as a stepping-off point for this process.

Last Updated: Feb 9, 2015 | URL: <http://libguides.caltech.edu/theses> | [Print Guide](#) | [RSS Updates](#)

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**My Profile**



**Kathy Johnson**


Contact Info  
Millikan Library 1-32  
California Institute of Technology  
Pasadena, CA 91125

**Required Documents for PhD Candidates**

Official certification of degree completion will not be provided until all the steps have been completed.

- **Required Forms in REGIS:** Log on to the Graduate Degree Progress application within [REGIS](#) using your Access credentials.
  - **Ph.D. Candidacy:** Ph.D. Candidacy must be completed before beginning fourth year of residence. Students should log

<http://libguides.caltech.edu/theses>



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Kathy Johnson, our Institutional Repository Librarian, teaches several classes each term on the overall process for thesis depositing and related graduation requirements. She also maintains an online LibGuide to assist students and answer questions. (Nice to see the recognition by Tony of ETDs.)





## So, What is Value?

Downloads? Citations?

Service to the community? Cost justifications?

<http://www.caltech.edu/content/mission-statement>

"The mission of the California Institute of Technology is to **expand human knowledge** and benefit society through research integrated with education. We investigate the most challenging, fundamental problems in science and technology in a singularly collegial, interdisciplinary atmosphere, while educating outstanding students to become creative members of society."

<http://www.caltech.edu/content/our-vision>


"Caltech was founded on the premise of **learning through discovery**, and cultivates an environment where scientists and engineers can pursue solutions to the world's greatest challenges."



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So we've talked about what CODA is, and what it provides, and why. So the next question is, "so what?" What is value / impact? Like Robert mentioned, are these easy-to-measure metrics useful beyond justifying a political agenda? And why does it matter so much in academia? Everything needs to have its cost justified, from subscriptions to salaries. The cost for CODA is in staff time, so is it worth it to provide this resource for the world? Reminiscent of the CCDC, influencing future research, here are Caltech's Mission and Vision statements. Advancing knowledge for its own sake is what academia is really about, not treating faculty as factories. The demand for our materials demonstrates their value – things won't get used if they aren't out there. And like the desktop CSD, there may be applications we may never know about. These tools also serve faculty needs as well in terms of promotional material and citation list management, so internal value should not be overlooked.



# Future Work


## Refine tools

Keyword searching, heatmaps, etc.  
Citation rate vs. AUTHORS posting date  
Other measures of value and impact?

**Are we really talking about engagement?**

Betsy Coles  
Kathy Johnson  
Caltech Library

## Acknowledgements



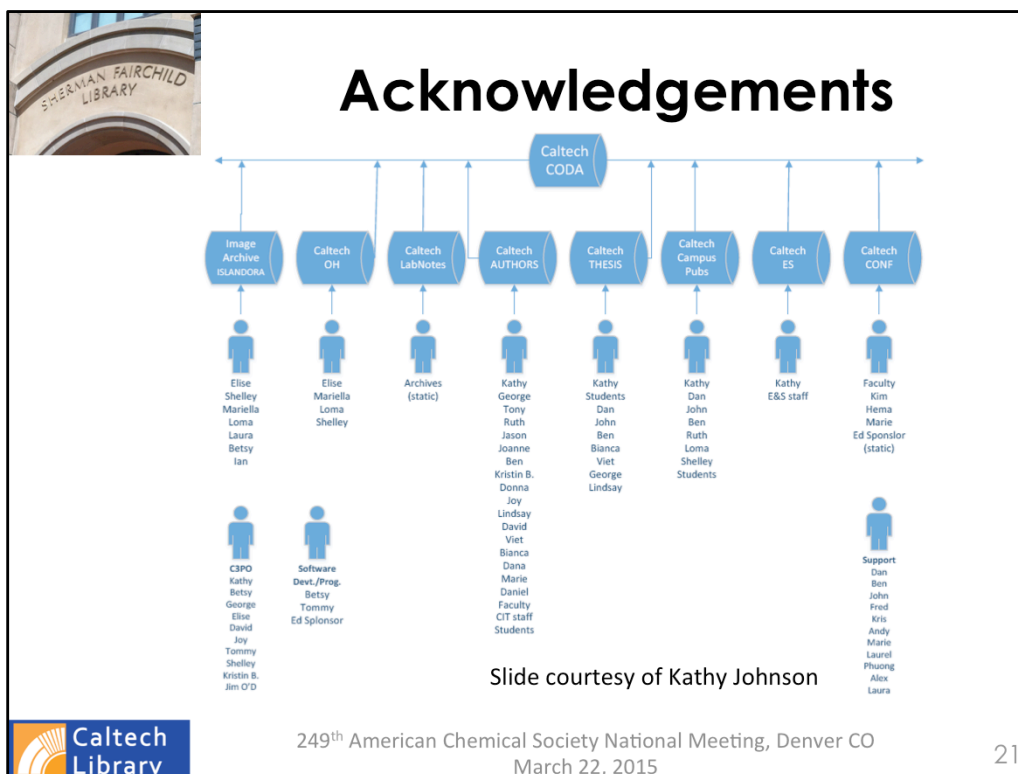
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Future work – repository software still may have a long way to go to get granular access data.

Engagement – Tony’s example of someone taking his work further and really engaging with it (versus something that could be considered “passive” like citations.)

A huge debt of thanks goes to Betsy Coles for wrangling the data out of our Eprints server, which allowed me to generate the heat maps. Kathy Johnson, along with my co-author George, teach several classes each term on CODA. And finally the Library for support. And of course...



...everyone who works so hard on CODA.